

Modification of L-31N and C-111 Canal Stage Operations. DRAFT (9/11/98)

Description of Simulation

Simulation (run) is based on the Central and South Florida Project, Restudy Alternative 3 (ALT3) with modifications to the operational criteria of structures to the south of G-211 on the L-31N, and C-111 canals, to lower their stages. The intent of the simulation was to determine the effect on the ENP and the potential reduction in flood risk to the lower East Coast service area (LECSA) resulting from lower canal operational criteria.

Assumptions

Operational criteria for structures on the L-31N and C-111 canals were changed for this run (denoted L31FC, for flood control) according to Table 1. Only structures for which the operational criteria are different from those of ALT3 are shown in Table 1. Note that the structure operational criteria depicted in Table 1 changed when the base simulations were revised and Alternative 3 became Alternative A.

Summary of Results

- Hydroperiod matches with NSM, within the Everglades National Park (ENP) improved from 84 to 90 percent. As a result of the increased pumping through the S332 structures, several model cells to the west of the C-111 canal, which in ALT3 (Fig. 1) had hydroperiods 30-90 days shorter than NSM, were ponded to within 30 days of NSM in the L31FC simulation (Fig. 2).
- Groundwater and levee seepage from the ENP to LECSA increased 31 percent from 292 kaf to 383 kaf (Table 2). The increase in seepage was more in the wet season (+57%) than in the dry season (+14%). Increased seepage was due to a larger difference between stages in the ENP and LECSA as a result of L-31N and C-111 canal stages being operated lower.
- Increased seepage resulted in slightly wetter (closer to NSM) Indicator Regions (IR, refer to Fig.3) to the east of C-111, namely in the C-111 Perrine Marl Marsh, (IR 4, Fig. 4) and in the North C-111 (IR 47, Fig. 5). Similarly, marsh areas to the west of L-31N in the Rockland Marl Marsh (IR 8, Fig. 6) and to the west and southwest of C-111 in the Mid-Perrine Marl Marsh (IR-3, Fig. 7) and Taylor Slough (IR-1, Fig. 8) were also slightly wetter. The North C-111 area was inundated for 407 weeks in L31FC compared with 340 weeks in ALT3 (NSM45P was inundated for 973 weeks).
- Overland flow across the western portion of Tamiami Trail into the ENP decreased slightly (by 2 percent, Table 2) while structural flow into the ENP increased by 5 percent (79 kaf, Table 2). Increased flow through the S355 structures (+6 percent) was reflected in the relatively small increase (+3 percent) in overland flow through the eastern portion of Tamiami Trail. Increased flow at the S332 structures was as a result of back pumping of the increased seepage. Surface water flows to Biscayne Bay remained unchanged.

- The mean annual water table elevation was higher to the west of the C-111 canal and lower to the east of the C-111 canal under L31FC (Fig. 10) than ALT3 (Fig. 9).
- Canal stages in the L-31N canal at S-174 were approximately 0.5 ft lower in L31FC than ALT3 (Fig. 11) for 70 percent of the time.
- Peak stages were higher under L31FC to the west of the C-111 canal (Fig. 12) and in the marsh areas to the east of the C-111 canal than in ALT3 (Fig. 13). In the agricultural areas to the east of L-31N and C-111, peak stages were lower in L31FC than ALT3.
- Flow down the L-31N canal through S331 was almost doubled (+56 kaf, Table 2) when the S331 was no longer closed in the wet season in L31FC. Flows down C-111 through S176 were increased 40 percent for the same reason. Much of this water apparently recharged the C-111 marsh areas on either side of the C-111 canal, as there was only a small increase (=3 kAF, Table 2) in flow to the C-111 E spreader canal.
- The potential for reducing the risk of flooding to the east of the L-31N and C-111 canal, with lower canal operational stages is shown in Figs. 14 through 18 which show the stage exceedance frequency curves for selected model cells. Stages were lower at each cell in the L31FC simulation than ALT3. At cell R10 C25 water table elevations were within 1 ft of the surface 2 percent of the time in L31FC compared to 15 percent of the time in ALT3 (Fig. 14). In both cases the water table was within 2 ft of the surface approximately 50 percent of the time. At R13 C25 the water table was within 2 ft of the surface approximately 50 percent of the time in L31FC compared with 65 percent of the time in ALT3 (Fig. 15). At R15 C26 the water table was within 2 ft of the surface 15 percent of the time in L31FC compared with 23 percent of the time in ALT3 (Fig. 16). At R17 C27 high water table elevations were 2 to 4 ft below the surface with the water table in L31FC up to 1ft lower than ALT3 (Fig. 17). At R19 C27 differences between L31FC and ALT3 water table elevations were small, with L31FC up to 0.1 ft lower than ALT 3 (Fig. 18).

Conclusions and Recommendations

Lower L-31N and C-111 canal operational criteria have the potential to improve hydroperiods in Everglades National Park due to increased overland flow to the ENP. However, for the most part, increased flow is due to the return of increased seepage. The increase in seepage from the ENP to the LEC improves hydroperiods in the C-111 marsh areas. Lower canal stages decrease the flood potential to the agricultural areas to the east of the canals. It was recommended that lower operational criteria be used for the L-31N and C-111 canals in Alternative 4 and subsequent Restudy alternatives.

Table 1. Modifications to C-111 operational criteria. Stages in feet.

C-111 Operational Criteria				As modeled for the C&SF Restudy using SFWMMv3.4			
Canal	Reach	Structure	Operation	95 Base	50Base, Alt1, Alt2	Alt 3	L31FC
L-31N	S-355 to G-211	G-211	open	6.0	6.0 (6.2) ¹	6.5 (cl.)	6.0 (6.0)
			close	5.5	5.7	6.0	5.5
		S-338	on	5.8	6.0	6.5 (7.5)	5.8
			off	5.5	5.8	6.2 (7.0)	5.5
L-31N	G-211 to S-331	S-331 and S-173	on	4.8	4.8	4.8 (cl.)	4.8
			off	4.3	4.3	4.3 (cl.)	4.3
L-31N	S-331 to S-176	S-194	open	5.3	6.0	6.0	5.3
			close	4.8	5.5	5.5	4.8
		S-196	open	5.5	6.0	6.0	5.5
			close	4.8	5.5	5.5	4.8
		S-176	open	5.0	6.6	6.6	5.0
			close	4.75	6.0	6.0	4.75
		S-332A	on	non-	5.5	5.5	4.85
			off	existent	5.1	5.1	4.65
		S-332C	on	non-	5.5	5.5	4.85
			off	existent	5.1	5.1	4.65
		S-332D	on	non-	5.5	5.5	4.85
			off	existent	5.1	5.1	4.65
C-111	S-176 to S-177	S-177	open	4.2	5.1	5.1	4.2
			close	3.6	4.5	4.5	3.6
	S-177 to S-18C	S-18C	open	2.6	3.5	3.5	2.6
			close	2.3	2	2	2.3

Note: 1. Values in () indicate wet season values where they differ from dry season values. (cl.) means structure closed during wet season. Structures with values in () can be used for flood control and water supply in the dry season but only for water supply in the wet season.

Table 2. Flows at selected locations. Units are in thousand acre-feet (kaf).

Location	ALT3	L31FC	ALT3-L31FC
Structural Flows into ENP			
S12's	451	439	-12
S333	468	470	+2
S355	364	386	+22
S356A+B	52	14	-38
S332A	41	70	+29
S332C	55	89	+34
S332D	69	111	+42
Total structural flow into ENP	1500	1579	+79
Overland flow into ENP			
Tamiami Trail West	435	425	-10
Tamiami Trail East (includes S355 flow)	826	847	+21
Flow down L31N and C-111			
S331	59	115	+56
S176	46	64	+18
S332E	3	5	+2
Groundwater seepage from ENP to LEC			
Dry season	177	202	+25
Wet season	115	181	+66
Total seepage from ENP to LEC	292	383	+91

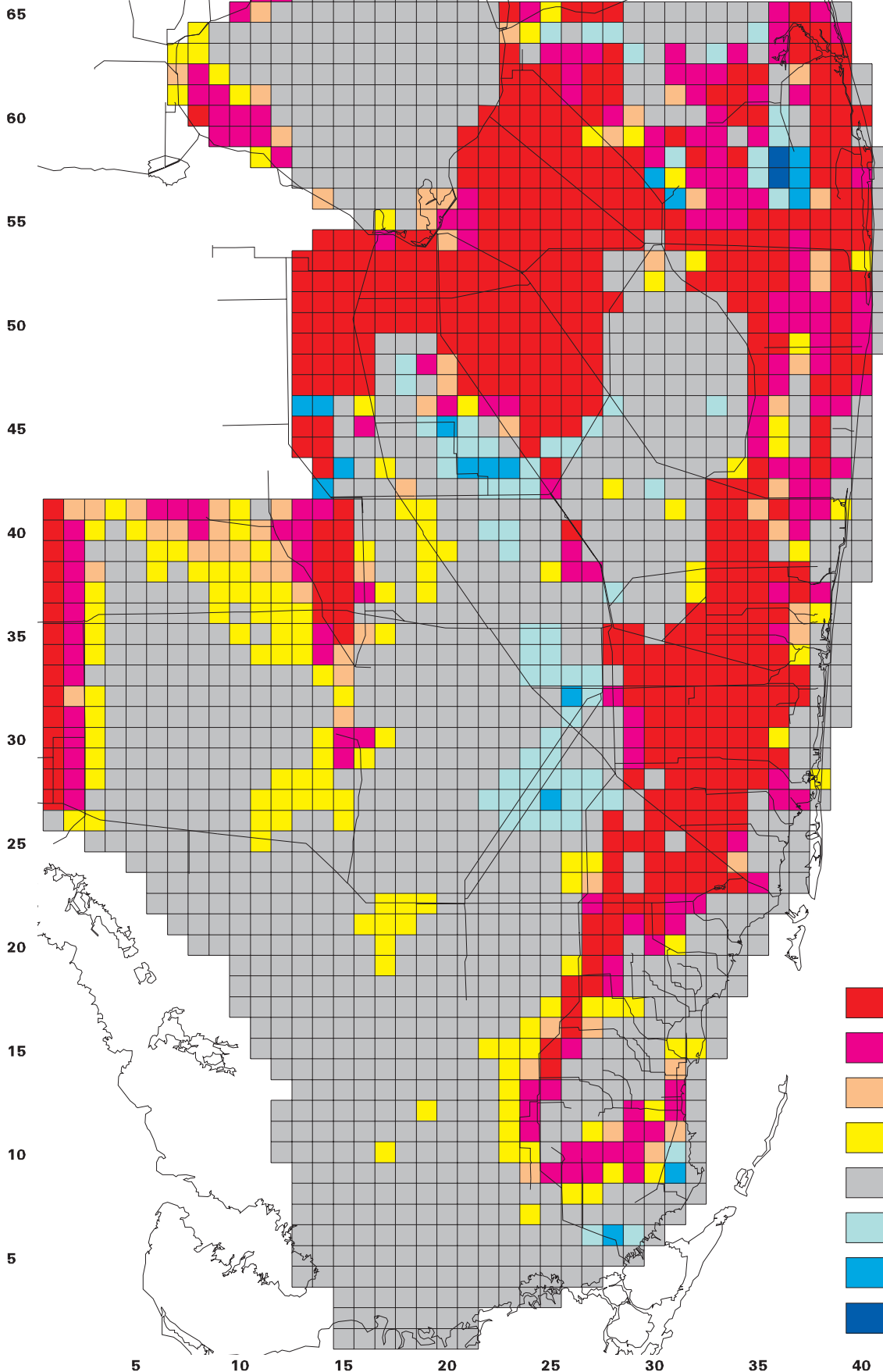
Fig . 1

ANNUAL AVERAGE HYDROPERIOD DIFFERENCES

ALT3 (RE STUDY)

SFWMM v3.4 relative to NSM v4.5

1965-1995 Simulation Period



Hydroperiod Difference Class (Days relative to NSM)

- 180-365 days shorter
- 90-180 days shorter
- 60-90 days shorter
- 30-60 days shorter
- +/- 30 days
- 30-60 days longer
- 60-120 days longer
- 120-365 days longer

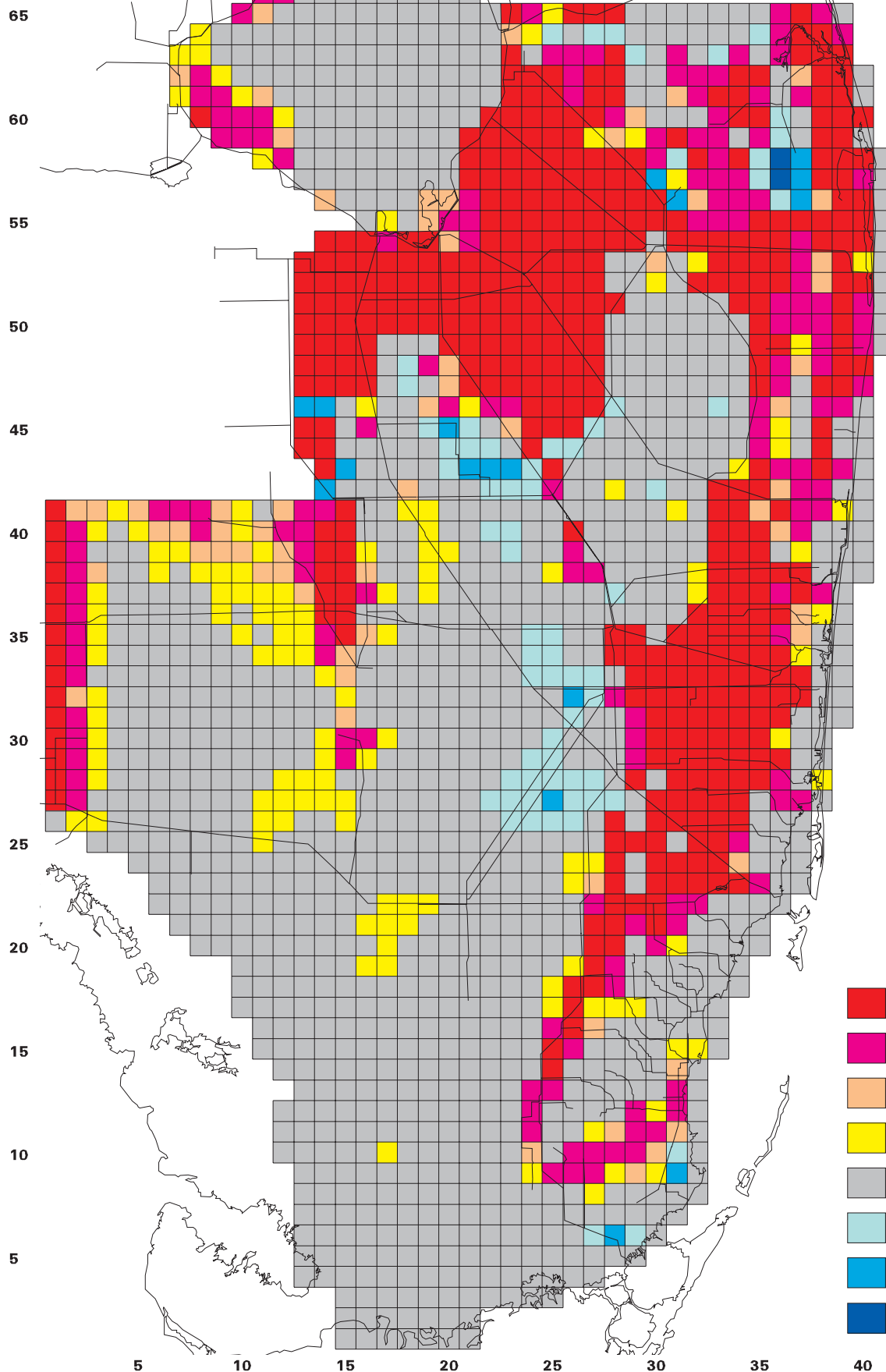
Fig . 2

ANNUAL AVERAGE HYDROPERIOD DIFFERENCES

SFWMM v3.4 –ALT 3 L31FC (RESTDY)

SFWMM v3.4 relative to NSM v4.5

1965–1995 Simulation Period

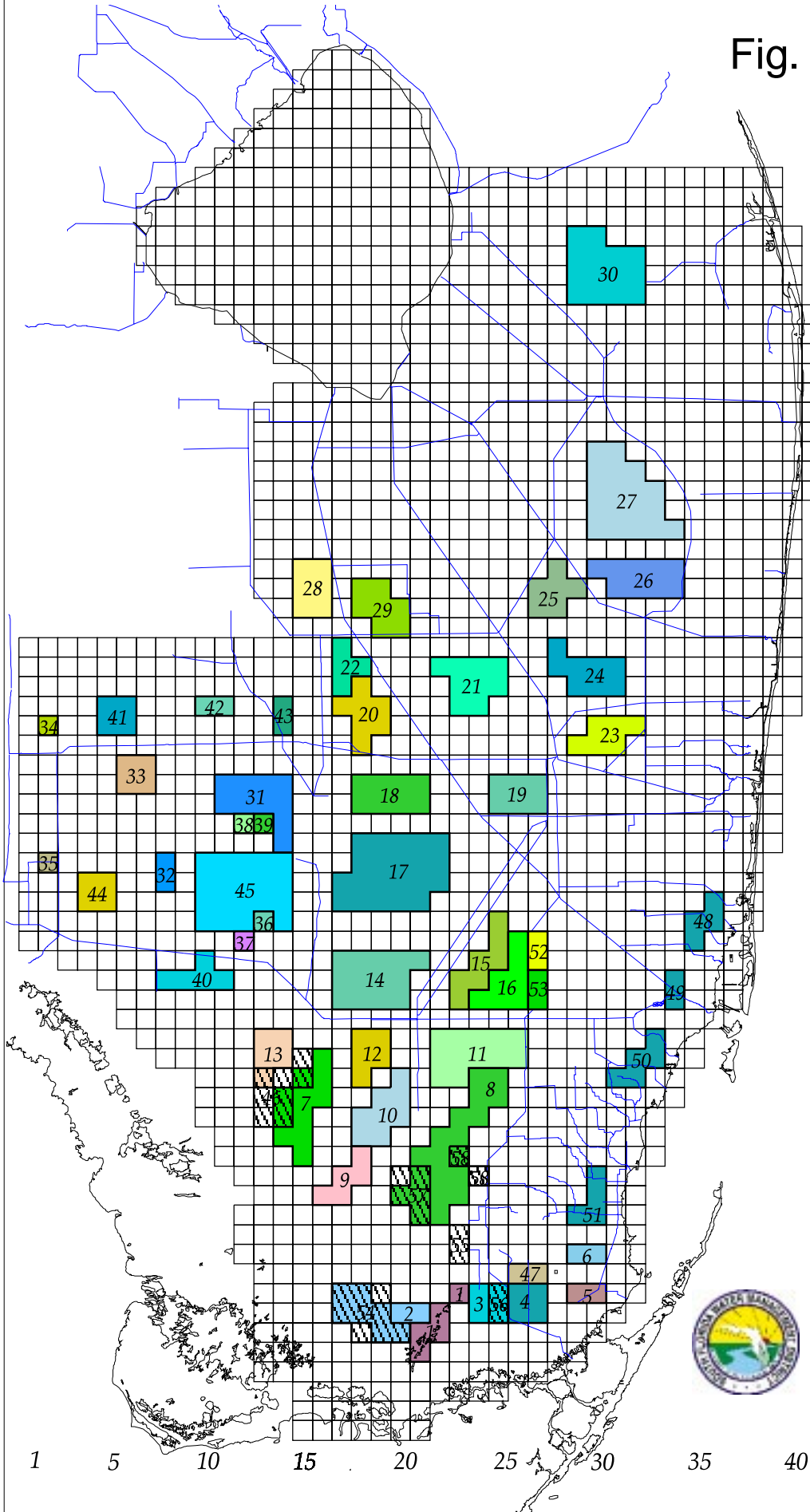


Hydroperiod Difference Class (Days relative to NSM)

- 180–365 days shorter
- 90–180 days shorter
- 60–90 days shorter
- 30–60 days shorter
- \pm 30 days
- 30–60 days longer
- 60–120 days longer
- 120–365 days longer

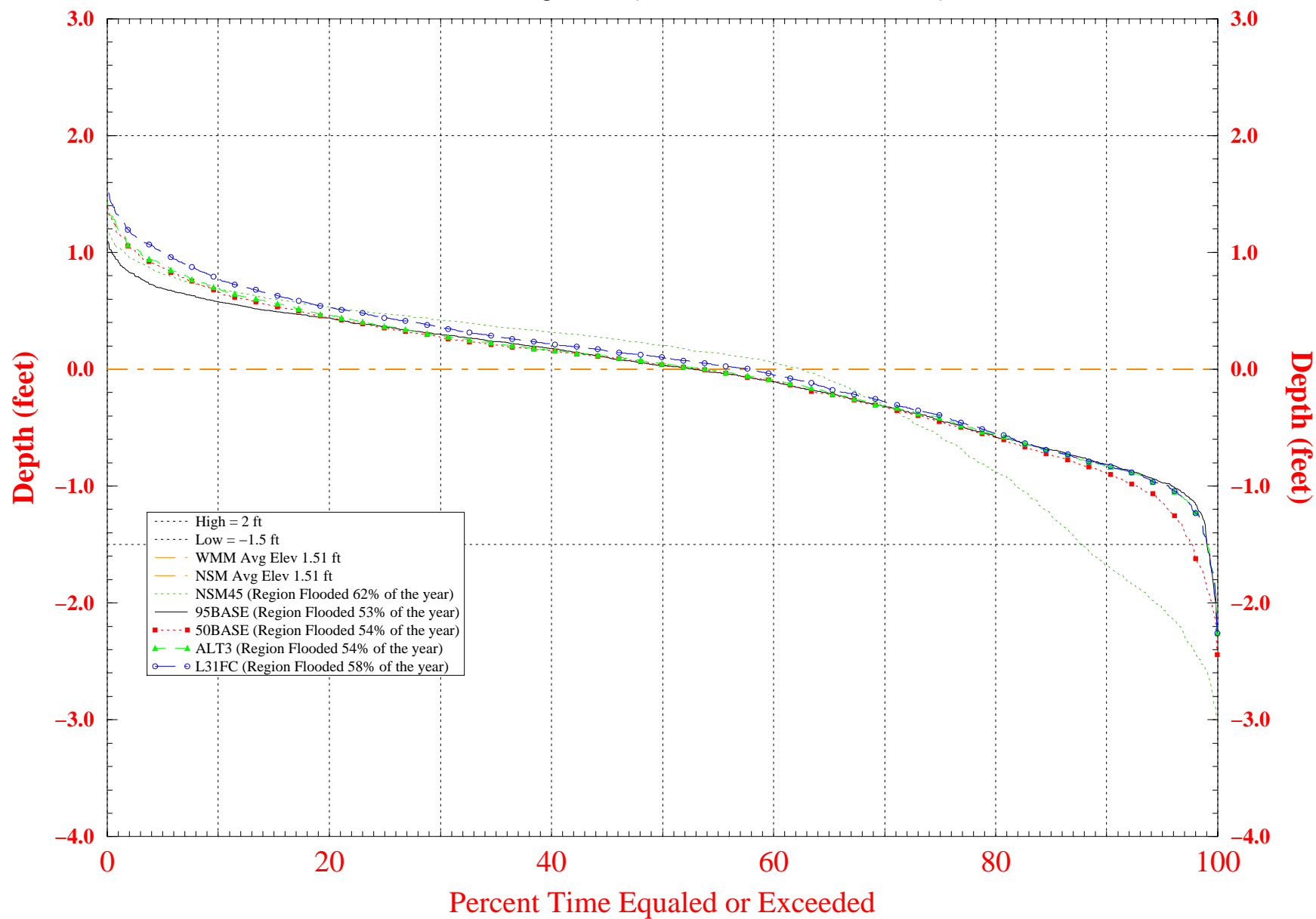
Fig. 3 Indicator Regions

Updated April 13, 1998



- 1= Taylor Slough
- 2= West Perrine Marl Marsh
- 3= Mid-Perrine Marl Marsh
- 4= C-111 Perrine Marl Marsh
- 5= Model Lands South
- 6= Model Lands North
- 7= Ochopee Marl Marsh
- 8= Rockland Marl Marsh
- 9= SW Shark River Slough
- 10= Mid-Shark River Slough
- 11= NE Shark River Slough
- 12= New Shark River Slough
- 13= West Slough
- 14= South WCA-3A
- 15= West WCA-3B
- 16= East WCA-3B
- 17= South Central WCA-3A
- 18= North Central WCA-3A
- 19= East WCA-3A
- 20= NW WCA-3A
- 21= NE WCA-3A
- 22= NW Corner WCA-3A
- 23= WCA-2B
- 24= South WCA-2A
- 25= North WCA-2A
- 26= South WCA-1 (LNWR)
- 27= North WCA-1 (LNWR)
- 28= Rotenberger WMA
- 29= Hole Land WMA
- 30= Corbett WMA
- 31= Mullet Slough
- 32= Upland Pine
- 33= Upper Mullet Slough
- 34= Cypress Marsh
- 35= Wet Prairie
- 36= Wetter Prairie NE
- 37= Wetter Prairie SW
- 38= Drier Cypress NW
- 39= Drier Cypress NE
- 40= Cypress
- 41= NW Big Cypress
- 42= NE Big Cypress
- 43= NE Corner Big Cypress
- 44= SW Big Cypress
- 45= Racoon Point
- 47= North C-111
- 48= N. Biscayne Bay Groundwater 1
- 49= N. Biscayne Bay Groundwater 2
- 50= Central Biscayne Bay Groundwater
- 51= S. Biscayne Bay Groundwater
- 52= Pennsuco Wetlands North
- 53= Pennsuco Wetlands South
- 54= Cape Sable Sparrow A
- 55= Cape Sable Sparrow B
- 56= Cape Sable Sparrow C
- 57= Cape Sable Sparrow D
- 58= Cape Sable Sparrow E

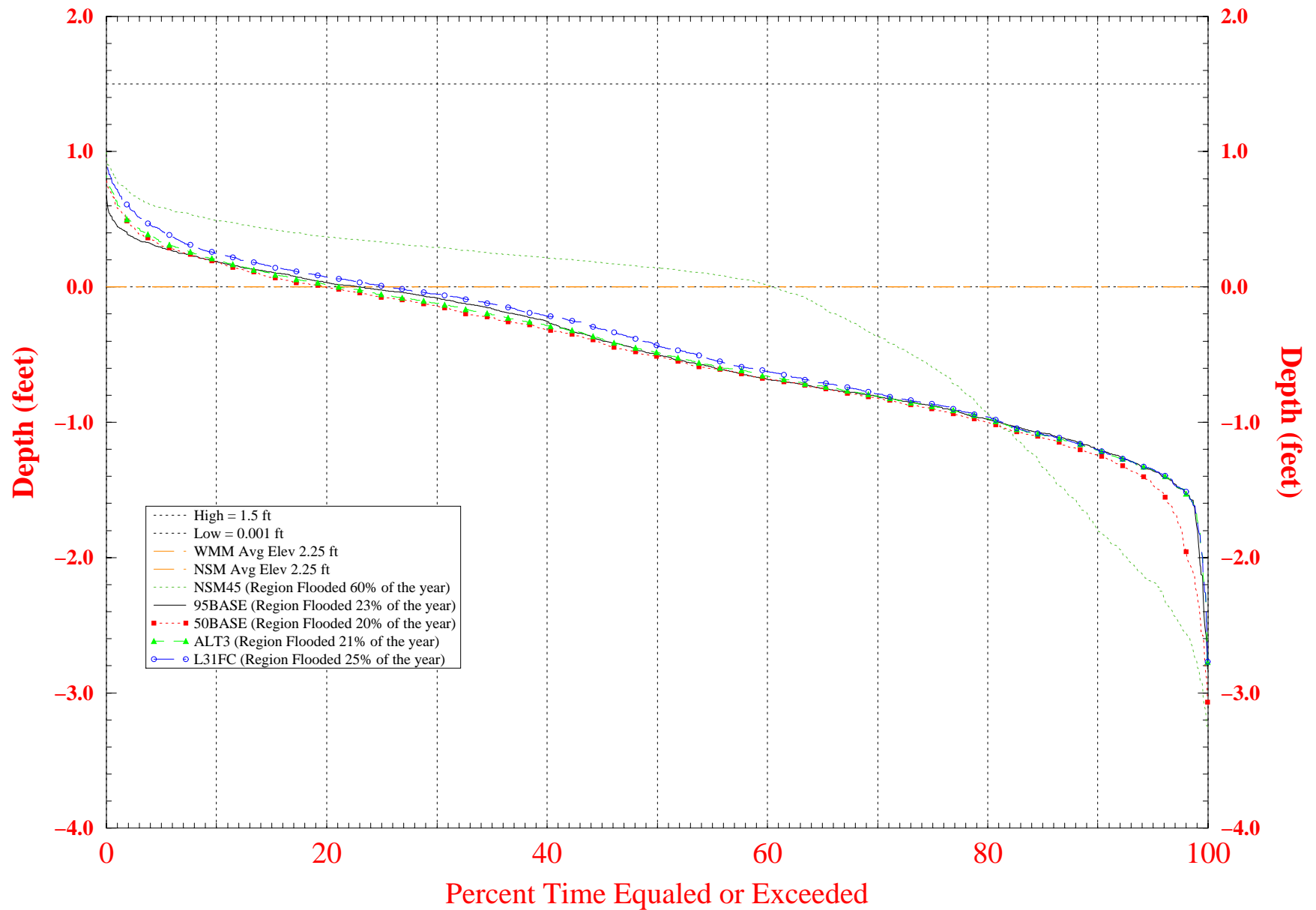
Fig. 4 Normalized Weekly Stage Duration Curves for C-111 Perrine Marl Marsh
Indicator Region 4 (R7C26-27 R8C26-27)



Note: Normalized stage is stage referenced to Land Elevation. Thus, values above zero indicate ponding while values below zero indicate depth to the water table.

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SFWMM V3.4

Fig. 5 Normalized Weekly Stage Duration Curves for North C-111
Indicator Region 47 (R9C26-27)

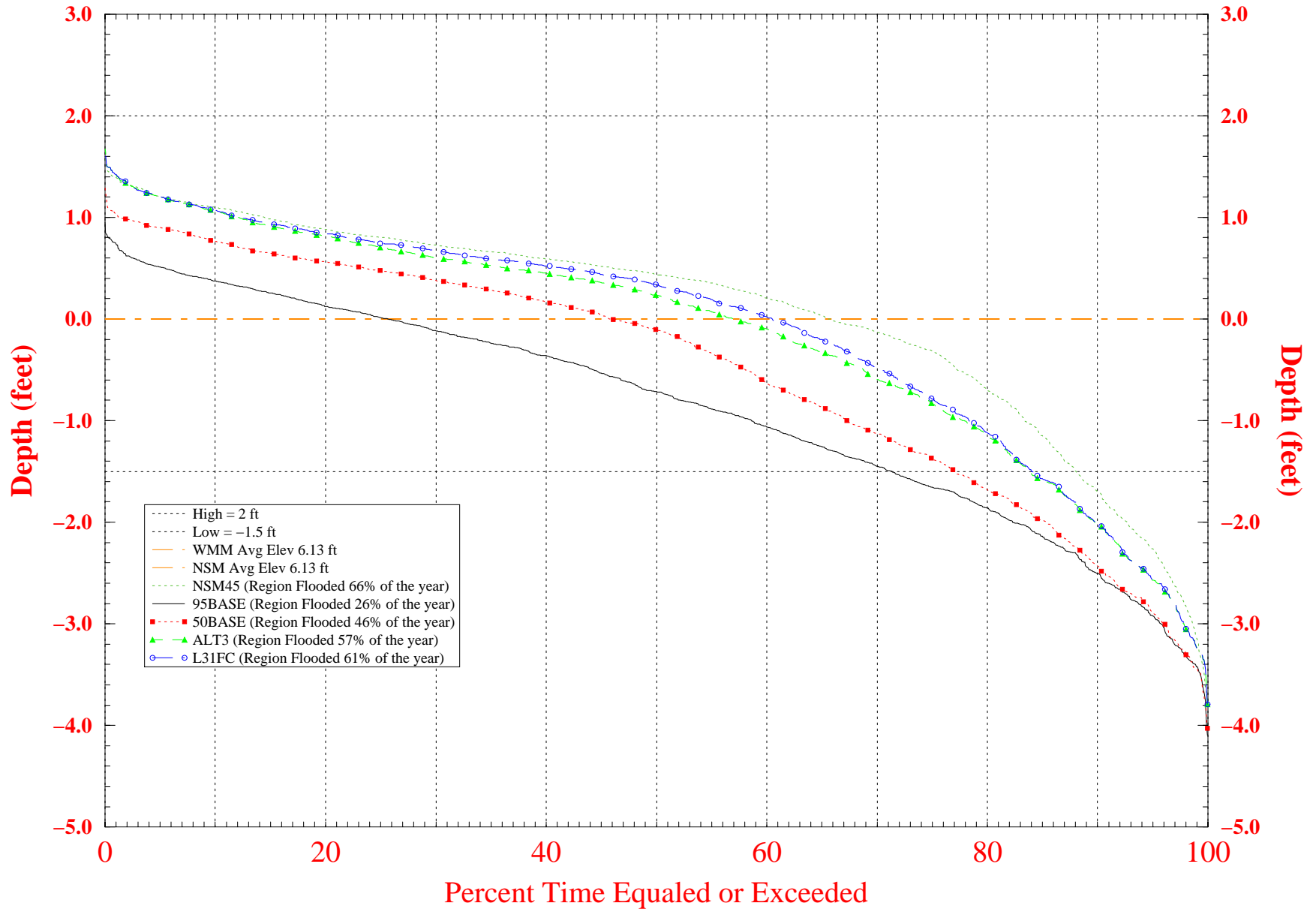


Note: Normalized stage is stage referenced to Land Elevation. Thus, values above zero indicate ponding while values below zero indicate depth to the water table.

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Fig. 6 Normalized Weekly Stage Duration Curves for Rockland Marl Marsh

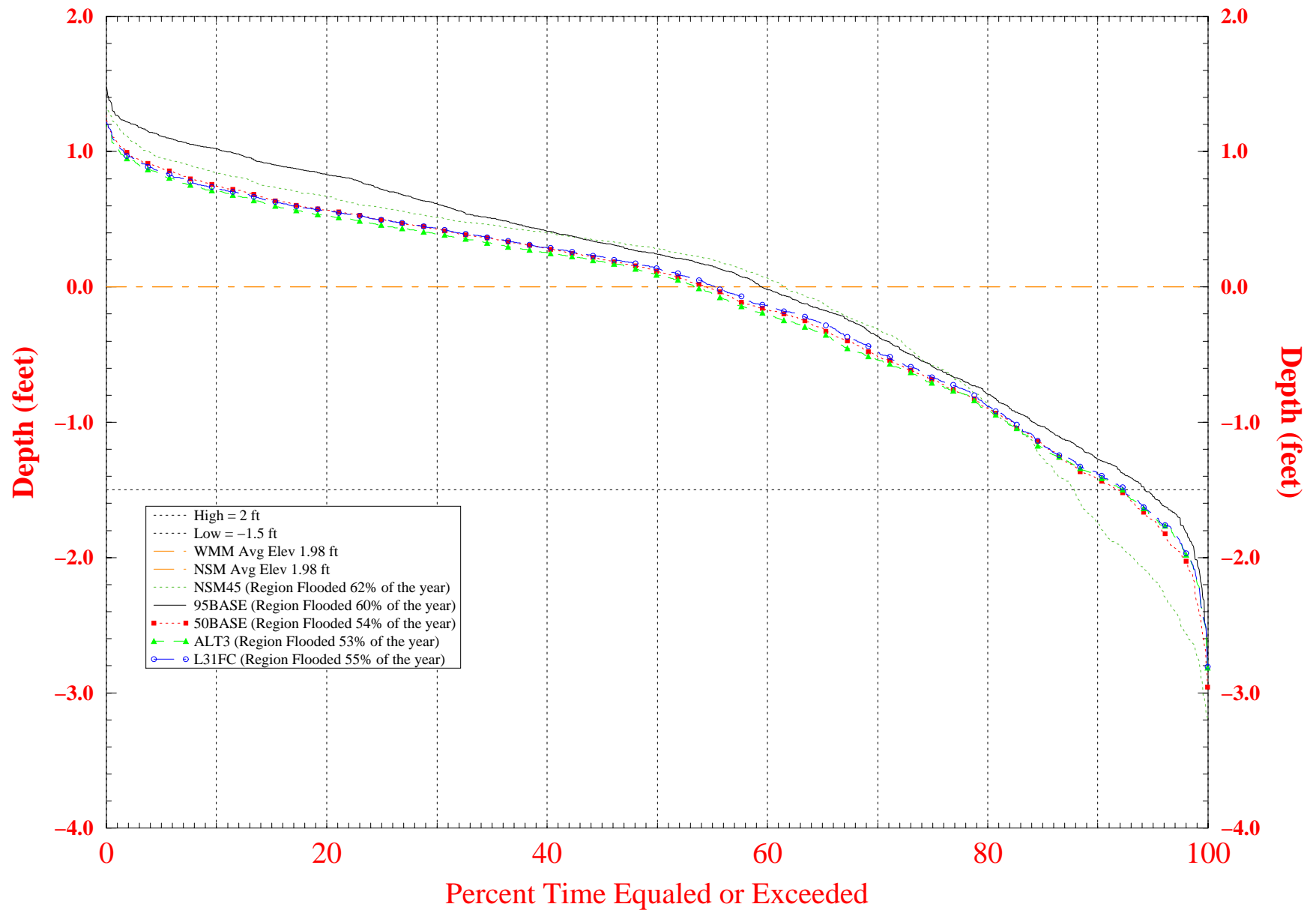
Indicator Region 8 (R12C21-22 R13C20-23 R14C21-23 R15C21-23 R16C22-23 R17C23-24 R18C24-25 R19C25-25)



Note: Normalized stage is stage referenced to Land Elevation. Thus, values above zero indicate ponding while values below zero indicate depth to the water table.

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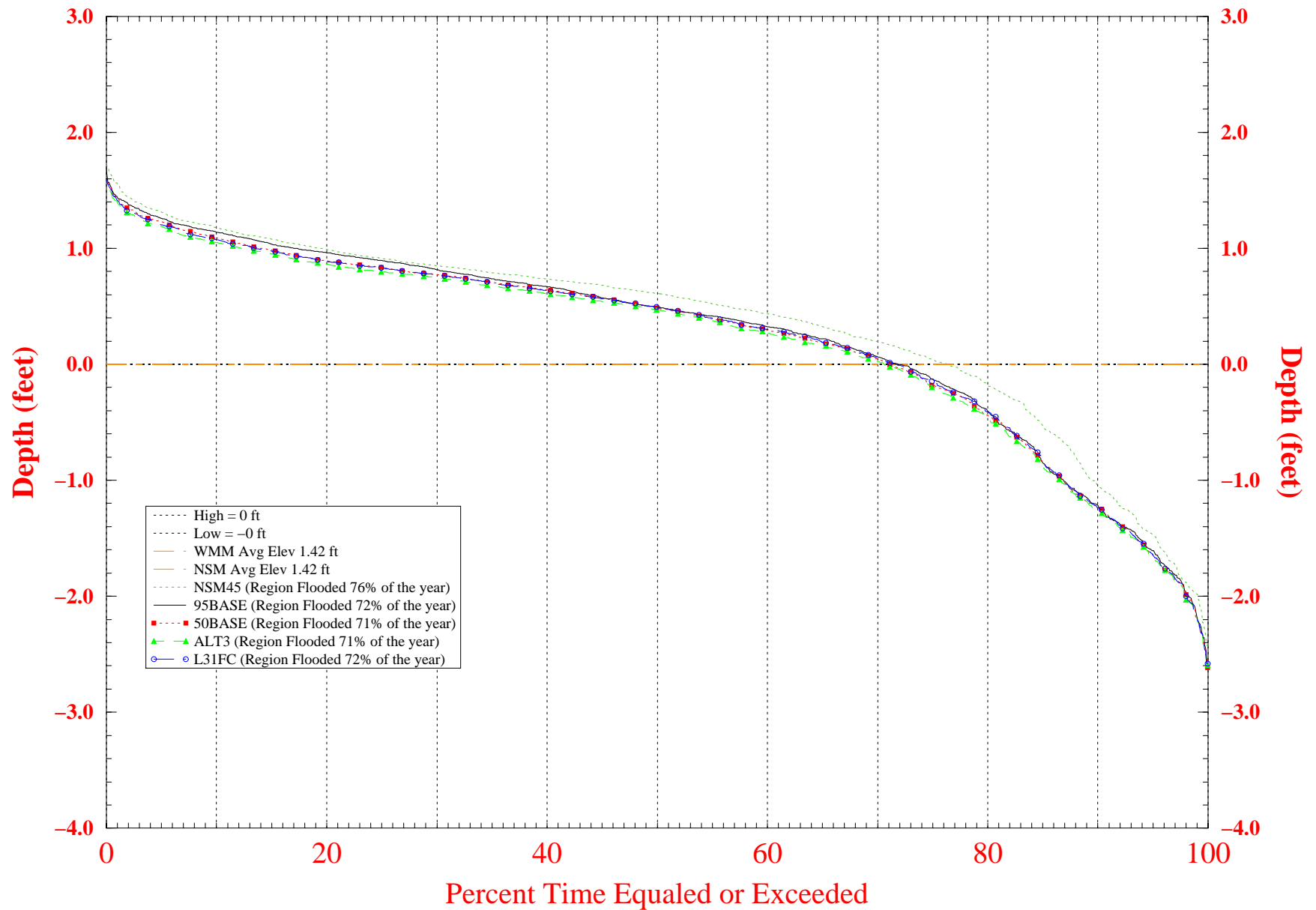
Fig. 7 Normalized Weekly Stage Duration Curves for Mid-Perrine Marl Marsh
Indicator Region 3 (R7C24-25 R8C24-25)



Note: Normalized stage is stage referenced to Land Elevation. Thus, values above zero indicate ponding while values below zero indicate depth to the water table.

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Fig. 8 Normalized Weekly Stage Duration Curves for Taylor Slough
Indicator Region 1 (R5C21-21 R6C21-22 R7C22-22 R8C23-23)



Note: Normalized stage is stage referenced to Land Elevation. Thus, values above zero indicate ponding while values below zero indicate depth to the water table.

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Fig . 9

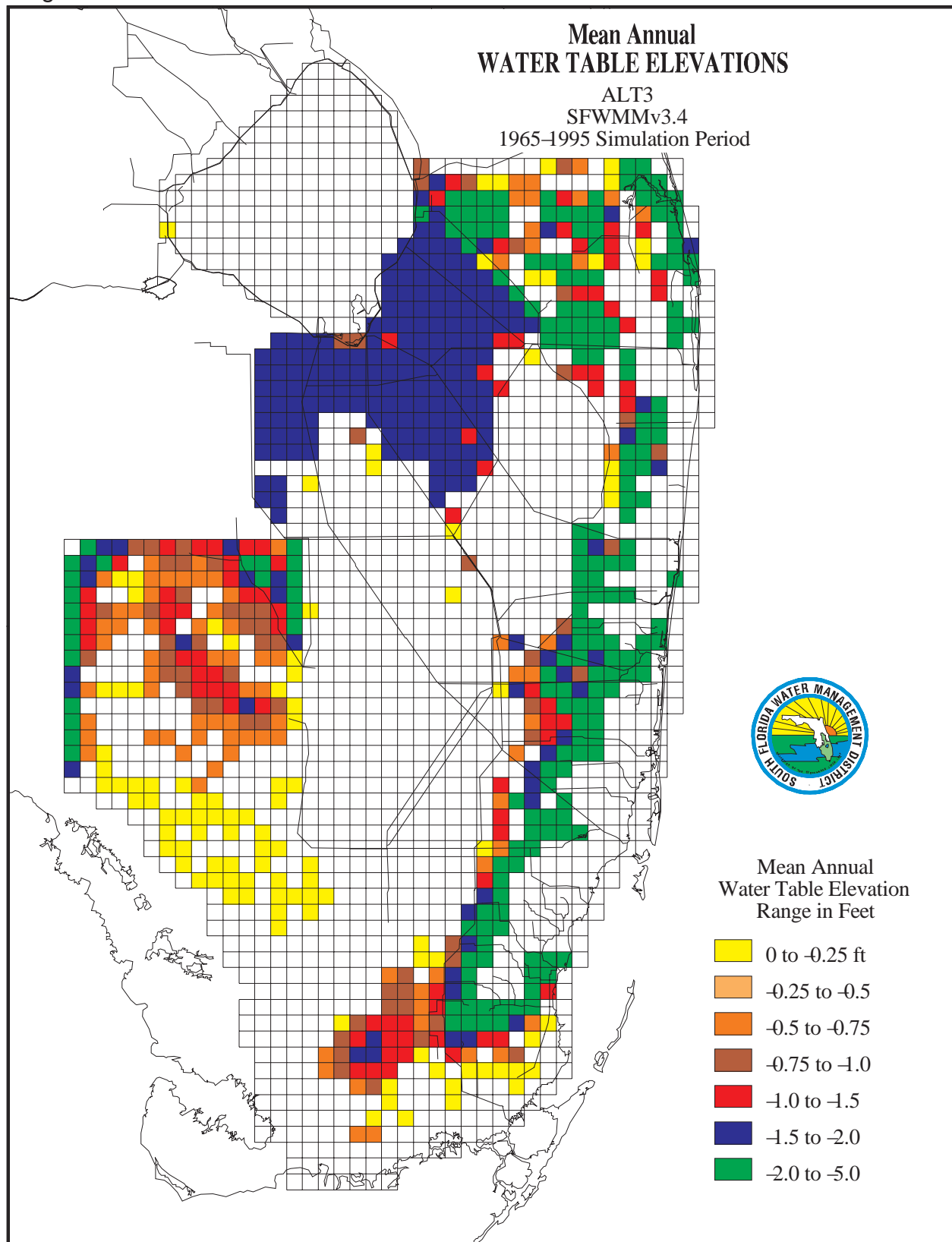


Fig . 10

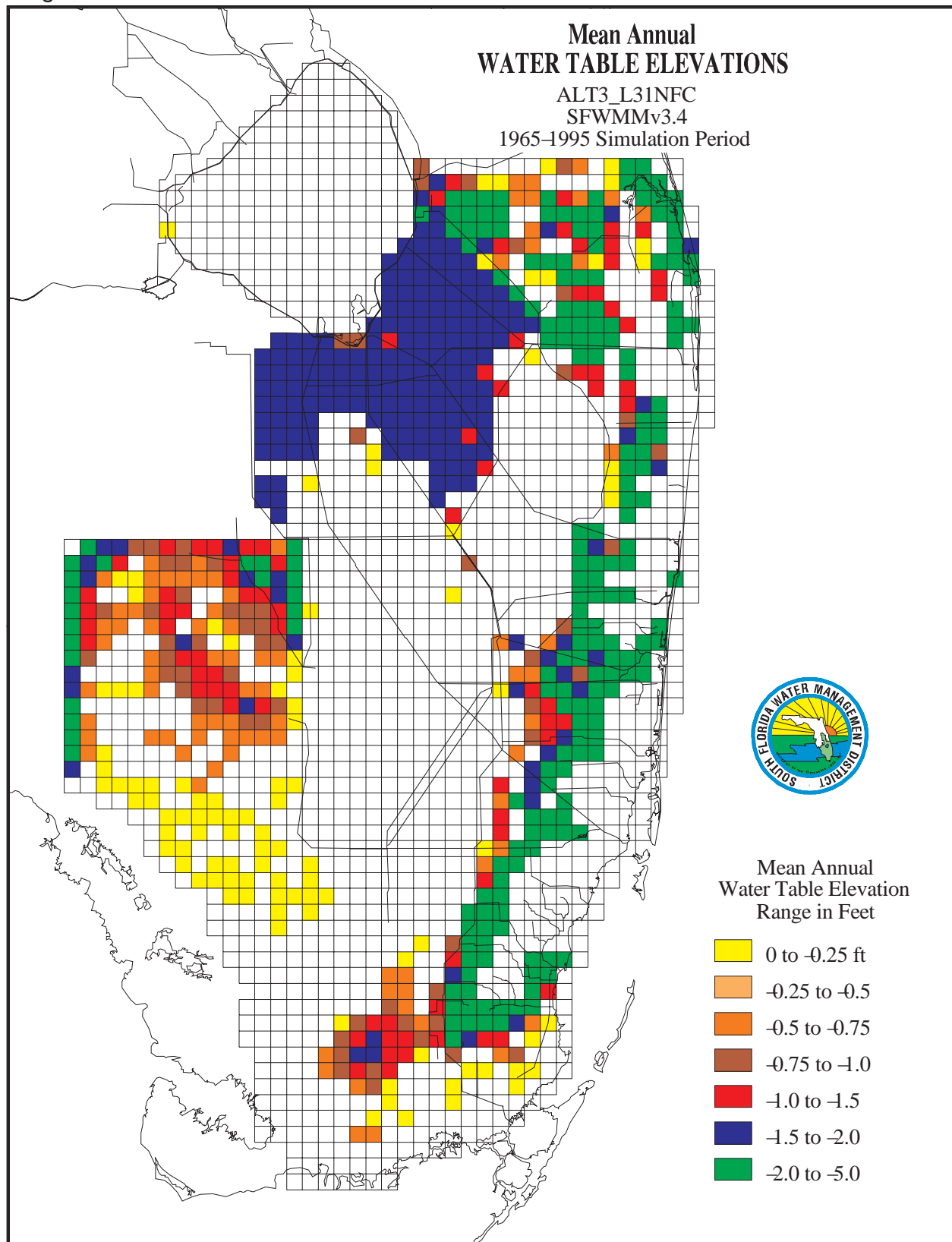
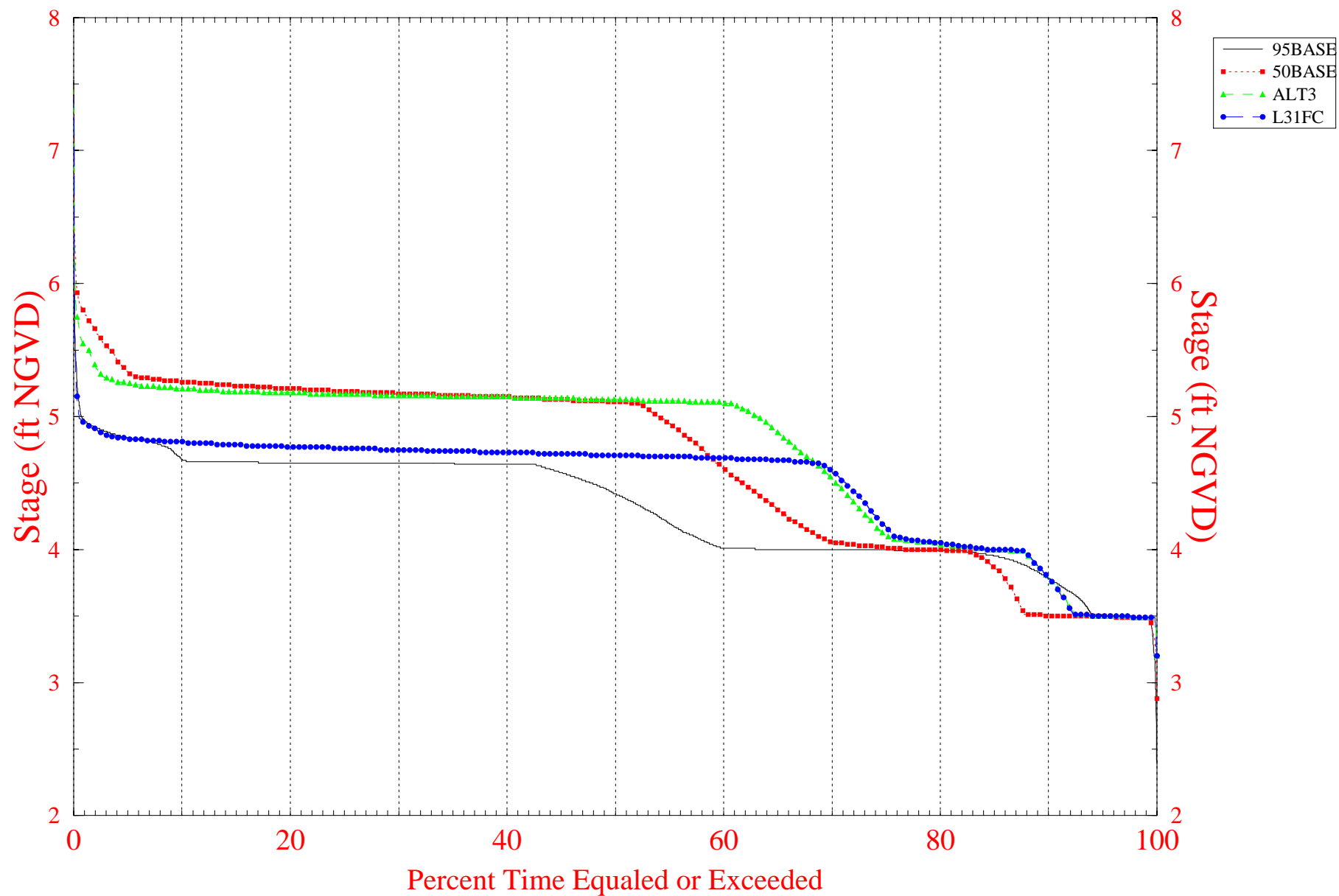
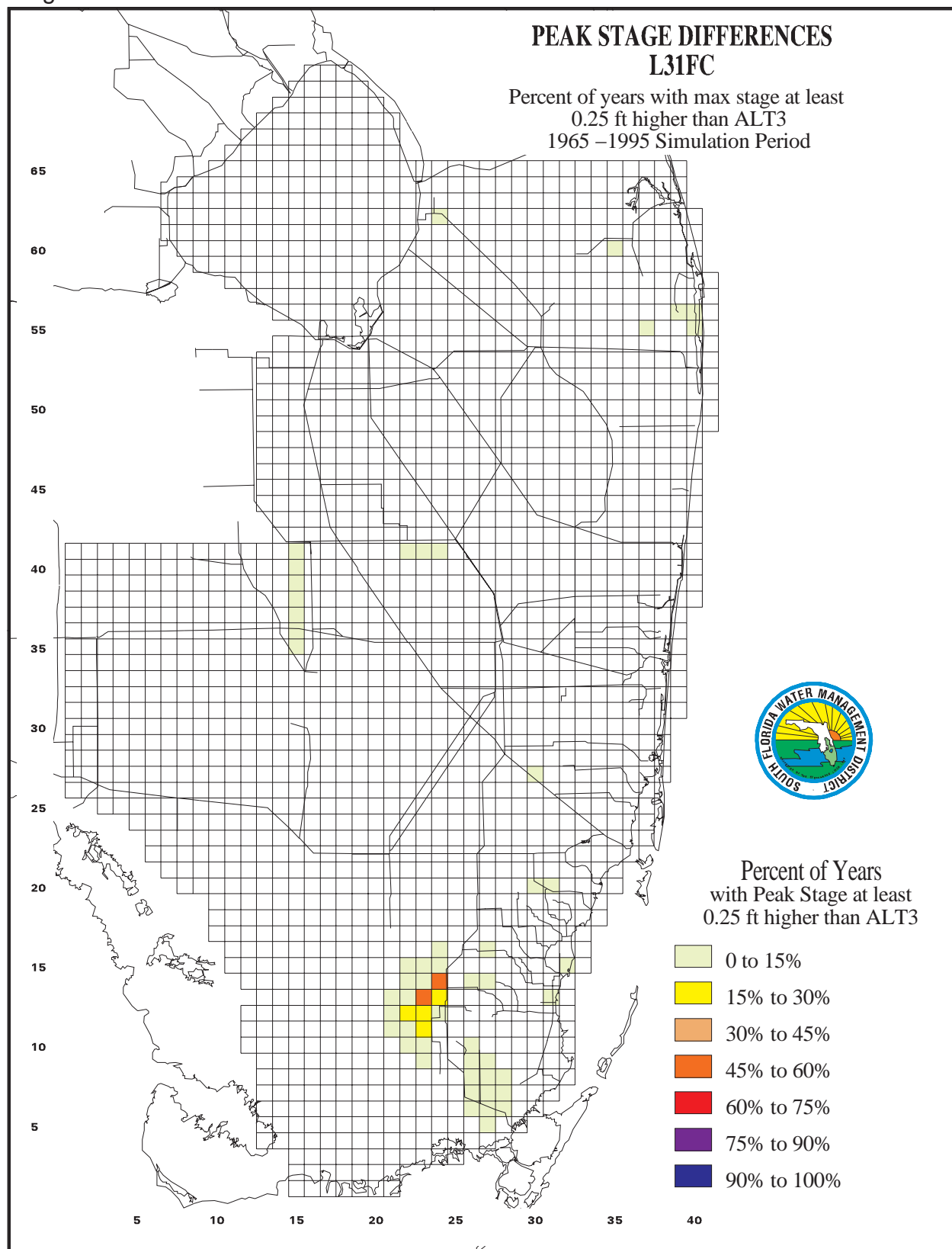


Fig. 11 Stage Duration Curves for L-31N Canal at S-174
(Salt-Water Intrusion Indicator Stage = 2.1 ft, NGVD)



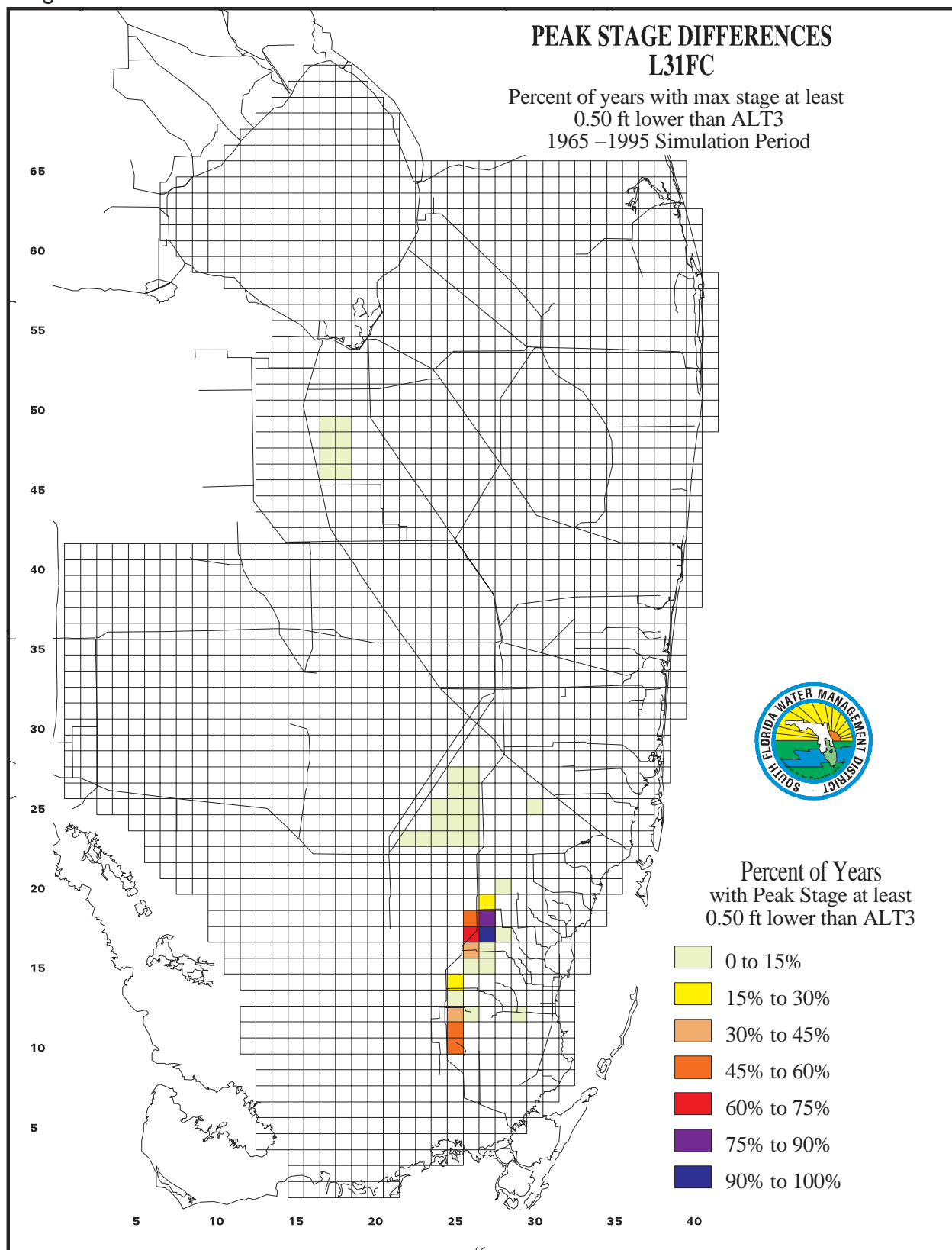
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Fig . 12



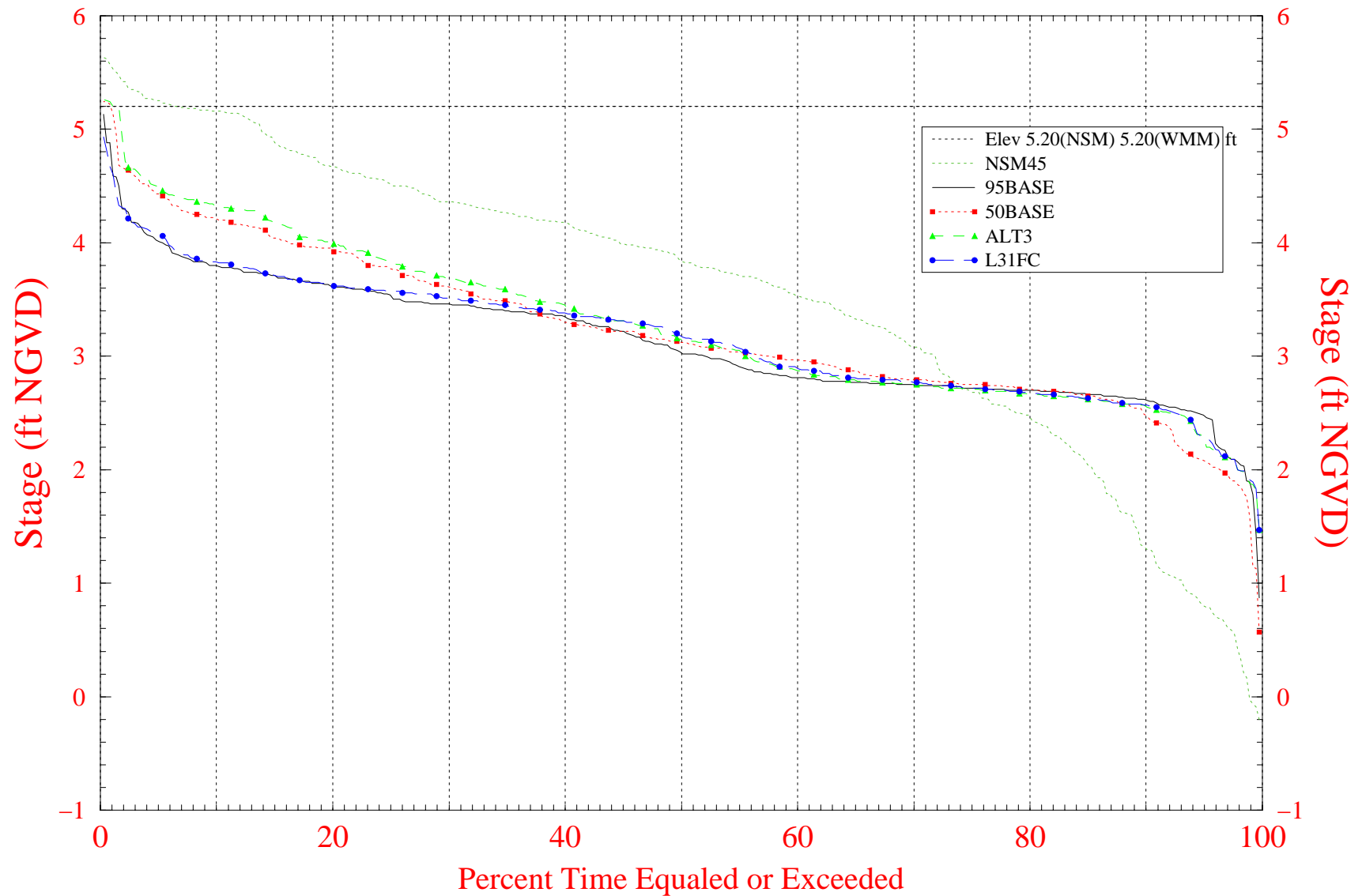
Note: Map values do not distinguish between groundwater and surface water and should only be used as a general indicator of subregions that may have a change in peak stages. Those subregions require more detailed investigation and analysis before site-specific inferences about changes in flooding risk can be made.

Fig . 13



Note: Map values do not distinguish between groundwater and surface water and should only be used as a general indicator of subregions that may have a change in peak stages. Those subregions require more detailed investigation and analysis before site-specific inferences about changes in flooding risk can be made.

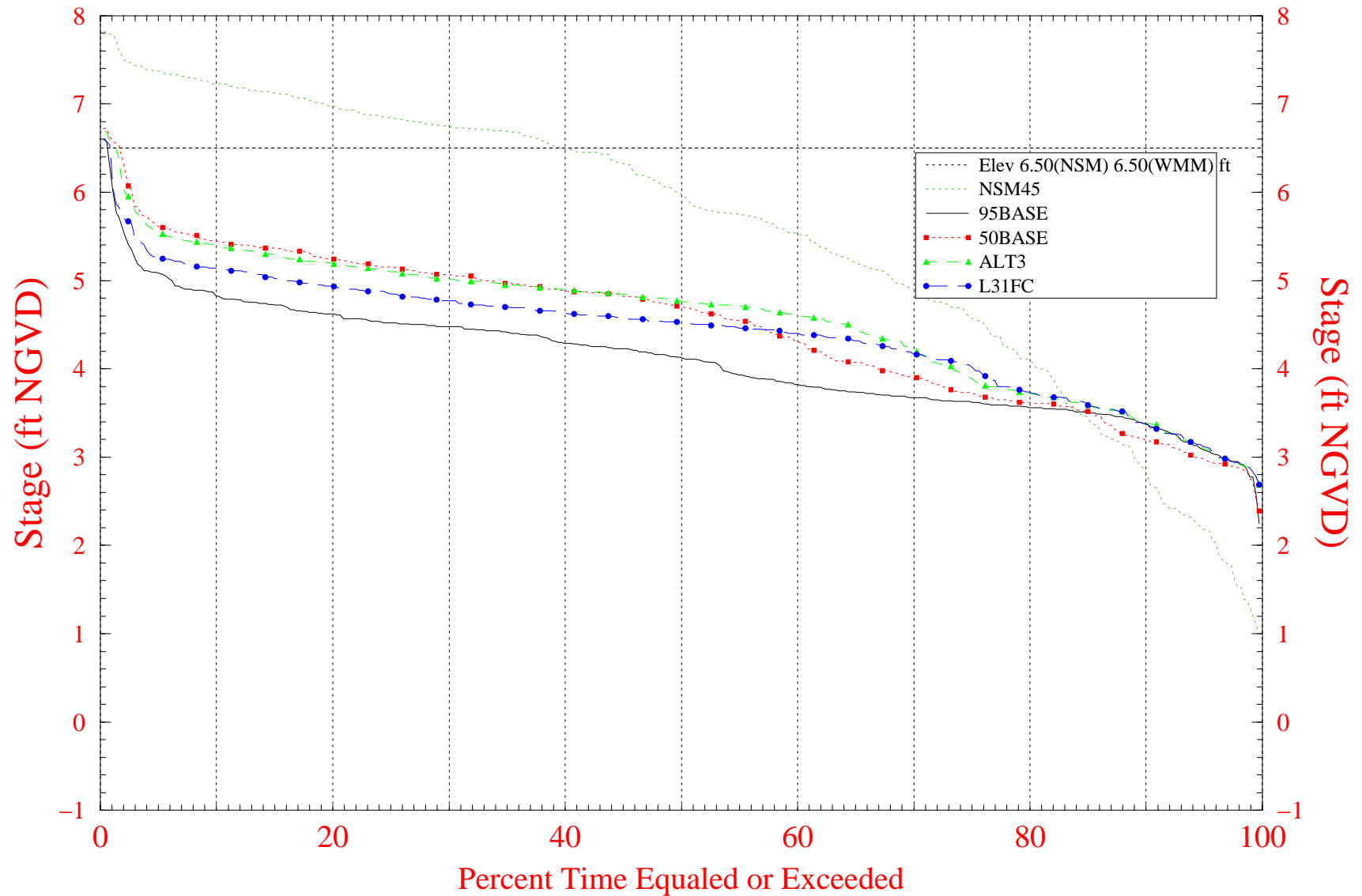
Fig. 14 End of the Month Stage Duration Curves at Cell R10 C25 in the LEC



Note: The simulated groundwater and surface water stages represent areally AVERAGED values over a 2-mile-by-2-mile region; the values DO NOT represent specific stages, or surface water depths and durations, for specific locations within the 4-square-mile grid cell. Land elevation values also represent areally AVERAGED values over the 4-square-mile grid cell.

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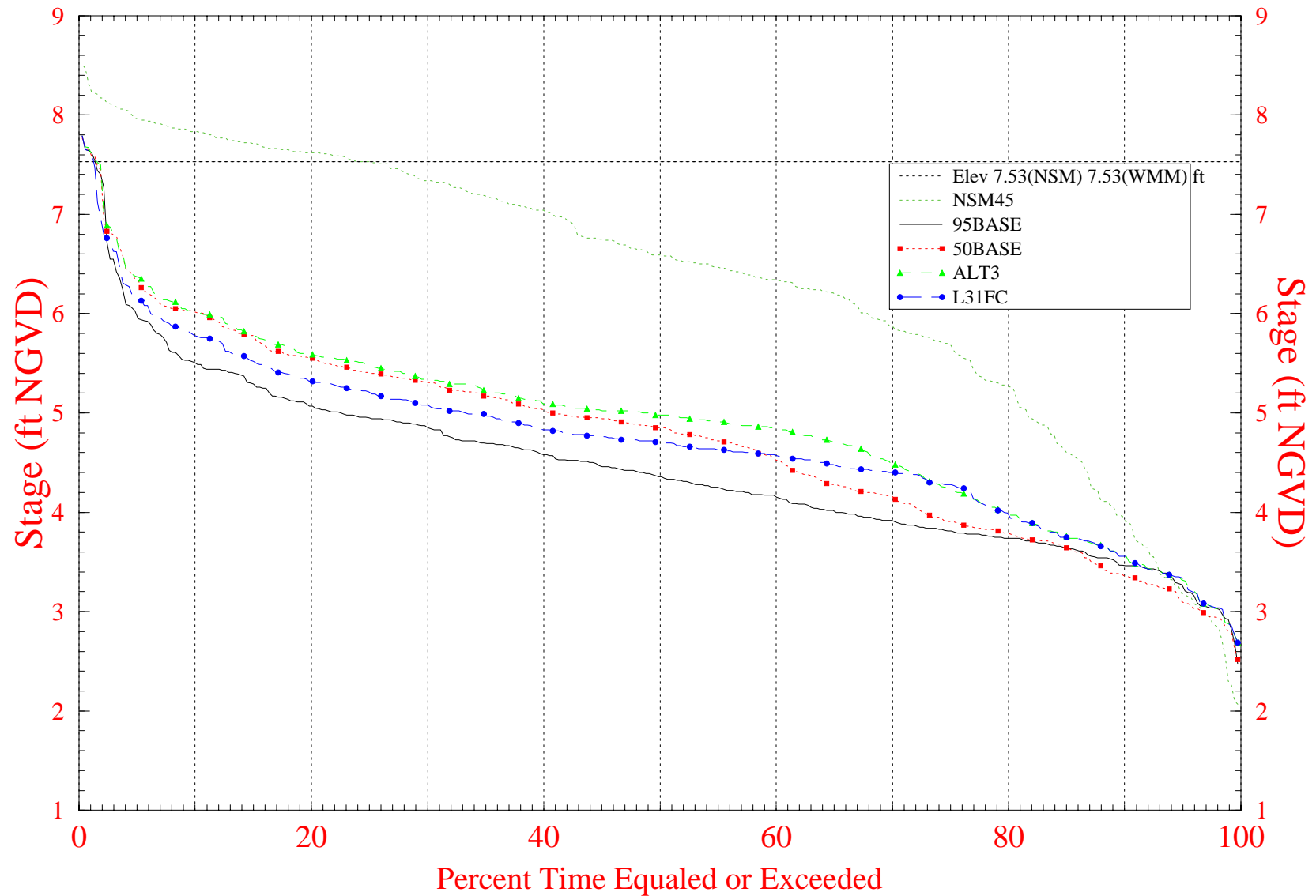
Fig. 15 End of the Month Stage Duration Curves at Cell R13 C25 in the LEC



Note: The simulated groundwater and surface water stages represent areally AVERAGED values over a 2mile-by-2mile region; the values DO NOT represent specific stages, or surface water depths and durations, for specific locations within the 4-square-mile grid cell. Land elevation values also represent areally AVERAGED values over the 4-square-mile grid cell.

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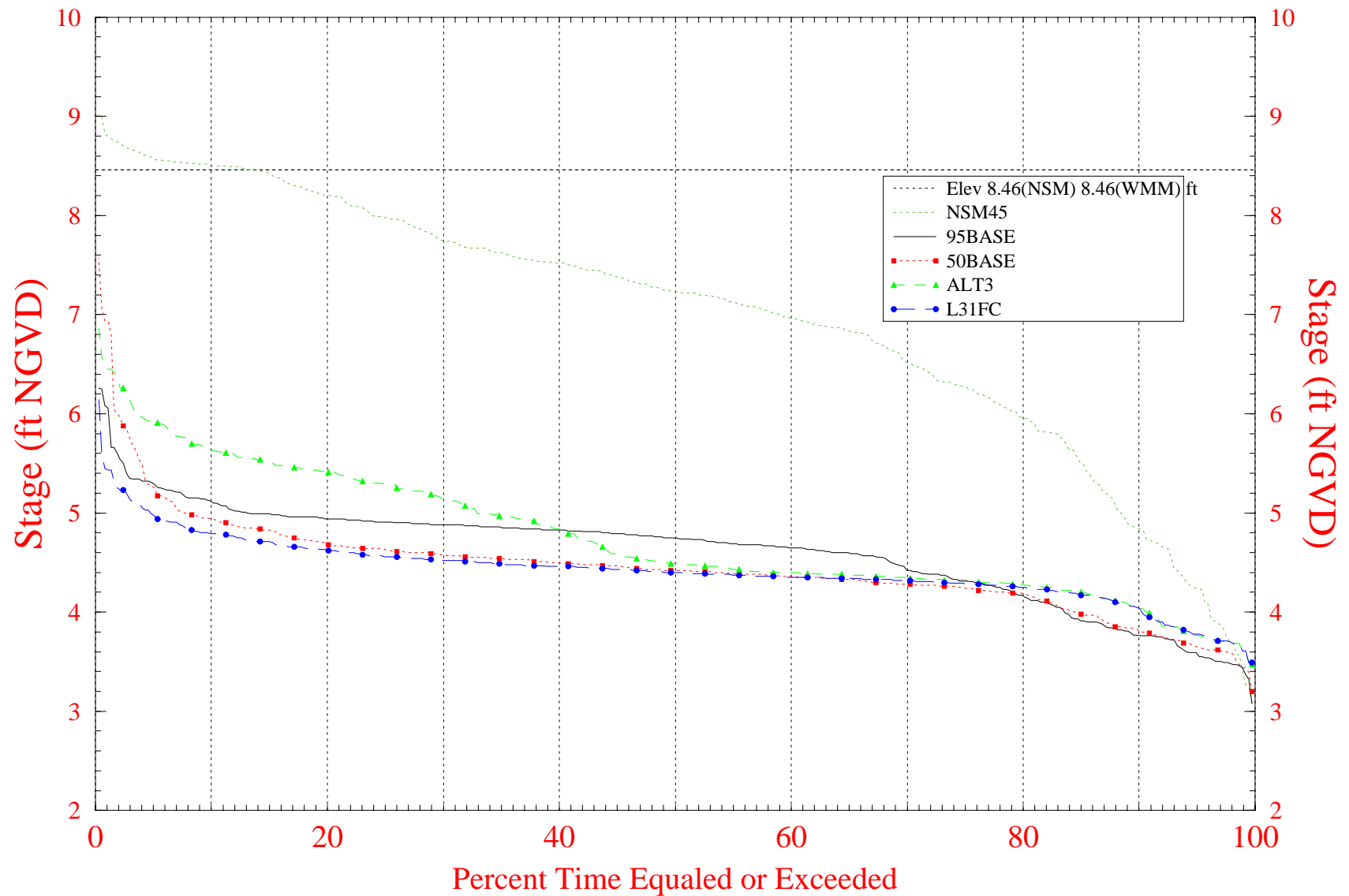
Fig. 16 End of the Month Stage Duration Curves at Cell R15 C26 in the LEC



Note: The simulated groundwater and surface water stages represent areally AVERAGED values over a 2-mile-by-2-mile region; the values DO NOT represent specific stages, or surface water depths and durations, for specific locations within the 4-square-mile grid cell. Land elevation values also represent areally AVERAGED values over the 4-square-mile grid cell.

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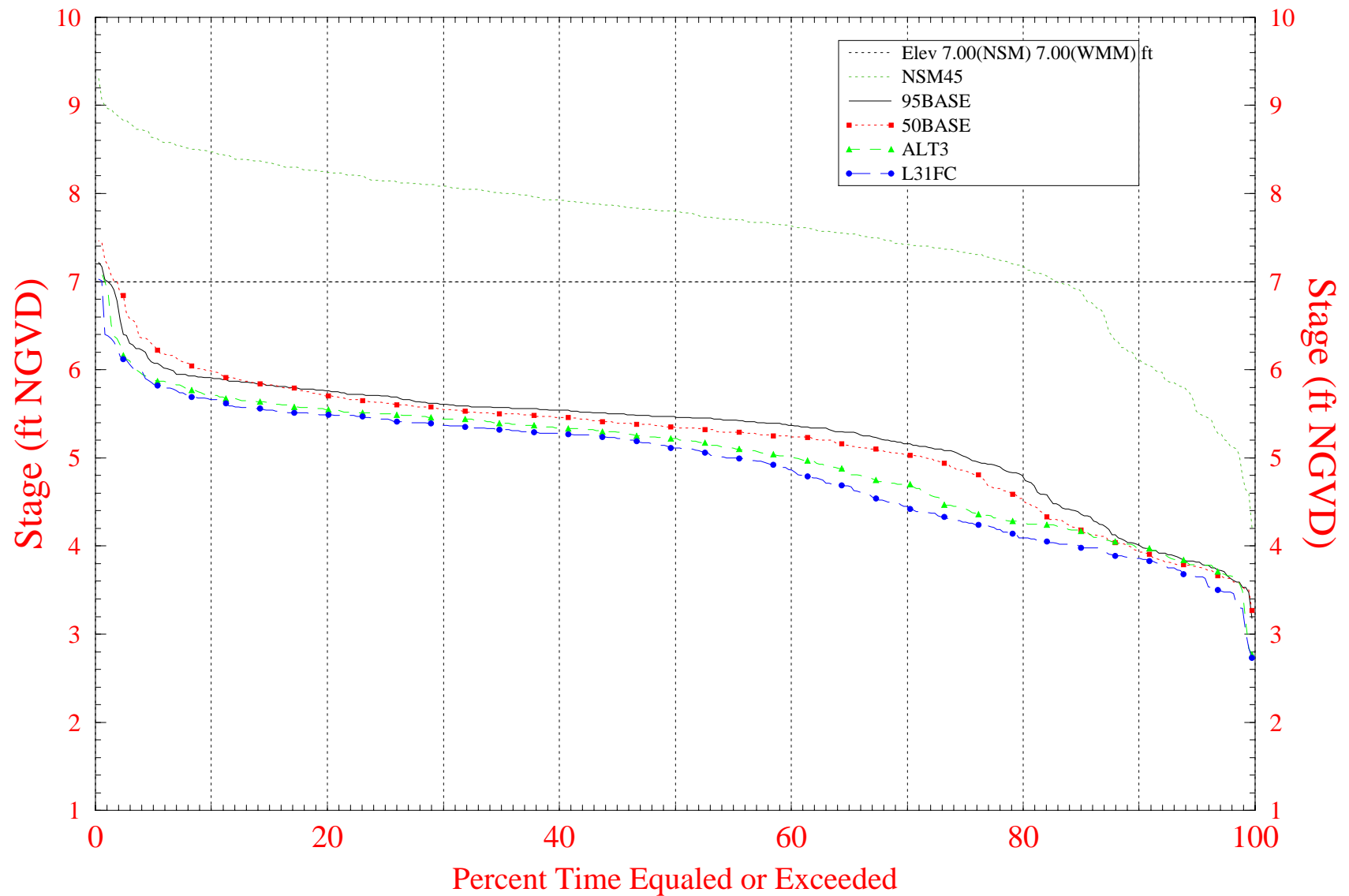
Fig. 17 End of the Month Stage Duration Curves at Cell R17 C27 in the LEC



Note: The simulated groundwater and surface water stages represent areally AVERAGED values over a 2mile-by-2mile region; the values DO NOT represent specific stages, or surface water depths and durations, for specific locations within the 4-square-mile grid cell. Land elevation values also represent areally AVERAGED values over the 4-square-mile grid cell.

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Fig. 18 End of the Month Stage Duration Curves at Cell R19 C27 in the LEC



Note: The simulated groundwater and surface water stages represent areally AVERAGED values over a 2-mile-by-2-mile region; the values DO NOT represent specific stages, or surface water depths and durations, for specific locations within the 4-square-mile grid cell. Land elevation values also represent areally AVERAGED values over the 4-square-mile grid cell.

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